

ABSTRACT

Apparatus for active in situ multi-element gas sparging for
5 bioremediation or physico-chemical degradation for removal of
contaminants in a soil formation containing a subsurface
groundwater aquifer or a substantially wet unsaturated zone, the
multi-gas contained in bubbles, wherein the apparatus includes a
plurality of injection wells extending to a depth of a selected
aquifer; introducing an oxidizing agent comprising ozone mixed with
ambient air to provide a multi-element gas by means of microporous
10 diffusers, without applying a vacuum for extraction of stripped
products or biodegradation by-products, wherein said diffusers form
micro-fine bubbles containing said multi-element gas that oxidizes,
by stripping and decomposition, chlorinated hydrocarbons from the
aquifer and surrounding saturated soil formation into harmless by-
products; also including a pump for agitating water in the well
15 selecting microbubbles, injecting them into the aquifer and
effective to alter the path of micro-fine bubbles through a porous
solid formation whereby enhanced contact between the oxidizing
agent contained in each said bubble by stripping pollutant from
solution in ambient water into the mini-atmosphere of each bubble
20 effective to increase the efficiency and speed of remediation of a
site.